Chemical Bonding and Reactions

PS-4 The student will demonstrate an understanding of chemical reactions and the classifications, structures, and properties of chemical compounds.

PS-4.5 Predict the ratio by which the representative elements combine to form binary ionic compounds, and represent that ratio in a chemical formula.
Taxonomy Level: 2.5-B Understand Conceptual Knowledge

Key Concepts:
Binary ionic compounds
Chemical formula
Balanced charge

Previous/Future knowledge: In the 7th grade students translated chemical symbols and the chemical formulas of common substances to show the component parts of the substances (including NaCl [table salt], H_2O [water], $C_6H_{12}O_6$ [simple sugar], O_2 [oxygen gas], CO_2 [carbon dioxide], and N_2 [nitrogen gas]). (7-5.2) In Physical Science students will predict the ratio and write formulas for binary ionic compounds.

It is essential for students to
- Predict the charge of the ions that the atoms in Groups 1, 2, 16, and 17 will attain.
  - Group 1 metals form 1+ ions,
  - Group 2 metals form 2+ ion,
  - Group 16 nonmetals form 2- ions,
  - Group 17 nonmetals form 1- ions.
- Understand that a *chemical formula* indicates the ratio of atoms in a molecule or an ionic compound.
  - The formula tells what elements are in the substance using symbols, and
  - The formula indicates the number of atoms of each element in a unit of the substance using subscripts.
- Understand the meaning of the symbols and subscripts when given a chemical formula.
- Understand that compounds do not have a net charge, meaning that the negative charges balance the positive charges so that the compound as a whole is neutral.
- Write balanced chemical formulas for binary ionic compounds.
  - Balance the charges in chemical formulas of compounds that contain ions of the elements in Groups 1,2,16, and, 17 without being given the charges on the ions
  - Balance the charges on *binary ionic compounds* (two different elements bonded together) for any elements that form ionic compounds when the charges on the ions are given, thereby predicting the ratio of the ions in the formula of the resulting ionic compound.

It is not essential for the students to:
- Balance formulas for ionic compounds other than Group 1, 2, 16, and 17 unless charges are given;
- Understand percent ionic character.

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Assessment Guidelines:

The first objective of this indicator is to *predict* the ratio of ions in binary ionic compounds, therefore, the primary focus of assessment should be to infer from the charges for Groups 1,2,16, and 17 ions based on the periodic table the ratio between the two elements forming the ionic bond.
Another objective of this indicator is to *represent* this ratio of ions in the form of a chemical formula; therefore, the primary focus of assessment should be to write a balanced chemical formula.

In addition to *predict*, assessment may require students to

- *Infer* charges of Groups 1, 2, 16, and 17 ions;
- *Recognize* balanced ionic formulas; or
- *Exemplify* ions with 1+, 2+, 1-, or 2- charges.